Variations in Ambulance Use in the United States: the Role of Health Insurance

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Abstract

Objectives—The purpose of this study was to describe the associations between individual health insurance and ambulance utilization using a national sample of patients who receive emergency department (ED) care.

Methods—The data source was the National Hospital Ambulatory Medical Care Survey, years 2004 through 2006. Non-institutionalized patients between ages 18 and 65 years were included. The primary dependant variable was ambulance use. Multivariable logistic regression methods were used to assess the associations between health insurance status and ambulance use, and to adjust for confounders.

Results—A total of 61,013 ED visits were included, representing a national sample of approximately 70 million annual ED visits over three years. Ambulance transport was used in 11% of private insurance visits, 16% of Medicaid visits, and 13% of uninsured visits. In the adjusted model, visits by patients with Medicaid (aOR 1.60, 99% confidence interval (CI) = 1.37 to 1.86) and the uninsured (aOR 1.43, 99% CI = 1.23 to 1.66) were more likely to arrive by ambulance than visits by patients with private insurance. Ambulance use among the uninsured was most pronounced in metropolitan areas.

Conclusions—Ambulance use varies by health insurance status. Medicaid coverage and lack of insurance are each independently associated with increased odds of ambulance use, suggesting a disproportionate role for EMS in the care of patients with limited financial resources.

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INTRODUCTION

Emergency medical services (EMS) provide prehospital care for over 18 million patients per year, treating and transporting over 15% of all patients who seek care in hospital emergency departments (EDs).[1–3] Variations in the use of EMS care may be exacerbating well-documented strains on the delivery of prehospital care.[4] Excess use of EMS among patients with a variety of low acuity conditions have been described.[5–13] The potential adverse consequences of non-urgent ambulance use include increased hospital crowding, and limits to rapid ambulance response for patients whose condition requires immediate care. Conversely, patients with high-acuity conditions, who would likely benefit from rapid prehospital care, are under-utilizing these services.[14–16] For example, patients with ST-elevation myocardial infarction (STEMI), for whom rapid EMS care has been shown to improve outcomes, arrive at the ED by ambulance less than 50% of the time.[15,17] These variations in use of prehospital EMS care suggest that factors external to clinical acuity may play a role in ambulance utilization.

The extent to which health insurance possession is associated with variations in EMS use is not well understood. Studies have demonstrated that personal financial concerns are indeed associated with decreased or delayed EMS care for patients with serious symptoms, such as acute chest pain.[18,19] Yet, both lay and academic literature relate contradictory messages that speak to how insurance (and ability to pay) affects ambulance use: while some reports have sought to characterize ambulance "abuse" and identify EMS as a "free taxi ride" to the hospital for patients for whom insurance coverage is anticipated to defray a large portion of the cost incurred,[5,10,11,20] others have cautioned that elevated costs of ambulance care could interfere with patients seeking necessary care during an emergency.[21–23] As a consequence, improving current understanding regarding insurance possession and EMS use may serve to inform future policy interventions to benefit public health.

We sought to explore the associations of health insurance possession with ambulance utilization using national data. Previous investigations that have been limited to patients with specific clinical conditions or single sites of care, or have used unadjusted methods, suggest that those without private health insurance may disproportionately use EMS.[24–27] We investigated whether health insurance status (possession and type) is associated with acuity-adjusted ambulance use for adult patients seeking care within a nationally representative sample of U.S. EDs. The null hypothesis was that insurance status was not associated with ambulance arrival for patients seeking care in EDs

METHODS

Study Design

We conducted an analysis of data from the 2004 through 2006 National Hospital Ambulatory Medical Care Surveys (NHAMCS), an annual cross-sectional national sample of patients who presented to U.S. EDs. The University of Pennsylvania institutional review board determined that this study was exempt from review and informed consent requirements.

Study Setting and Population

The NHAMCS is a national probability survey conducted by the National Center for Health Statistics (NCHS) within the Centers for Disease Control and Prevention (CDC).[2] The NHAMCS includes individual visits made to selected hospitals in the U.S. Nonfederal hospital selection is made on a four-stage probability sample design based on geographic-based primary sampling units, which are a subsample for the National Health Interview Survey (NHIS). Hospital staff complete patient record forms for a sample of visits that

occurs during a randomly assigned four-week reporting period. Quality control includes computer checks to assess inconsistencies with value ranges at the central data entry site, a two-way, 10% independent procedure for coding, and adjudication by the NCHS for ambiguous responses. The non-response rate for items is generally <5%, and coding error rates are <2%. Detailed information on the survey methodology is provided elsewhere.[2]

We combined three recent years of NHAMCS ED data. Included in this study were adult (over 18 years) patient visits under the age of 65 years. Because this study specifically sought to explore the relationship between insurance status and ambulance use, visits for patients over 65 years were excluded due to the strong likelihood of these patients to both be insured (due to Medicare eligibility rules) and to use ambulance care.[28] Children under 18 years were excluded as they are likely to have unique factors influencing ambulance use (including proxy decision makers and specific medical conditions) compared to adults. Also excluded were patient transfers from nursing homes or other hospitals; ambulance use from these institutions was not expected to vary by insurance type, based on known high rates of ambulance use for transport from these facilities.[28]

Study Protocol

The data for the ED component of NHAMCS were obtained for years 2004, 2005, and 2006 and pooled. For analysis purposes, we recoded the 2005 and 2006 triage acuity variables to fit the four-level triage acuity categorization scheme used in the 2004 survey: "patient needs to be seen within 15 minutes," "15 to 60 minutes," "60 to 120 minutes," or "2 to 24 hours."

The primary outcome we studied was arrival by ambulance. We used arrival by ambulance compared to arrival not by ambulance as the dichotomous outcome variable. The independent variable of interest was primary expected source of payment. Categories included private insurance, Medicaid, Medicare, no insurance (divided into self-pay and no charge/charity), and other. The NCHS identifies "other expected payers" as any other sources of payment not covered by the above categories, such as the Civilian Health and Medical Program of the Uniformed Services, state and local governments, private charitable organizations, and other liability insurance (such as automobile collision). We collapsed workers compensation insurance into the "other" category for analysis purposes. Factors such as patient race, ethnicity, age, and destination hospital location and region of the country were examined as potential confounders. Clinical acuity assessed at ED triage by immediacy in which the patient should be seen was also included in the analysis as a covariate. The five most common clinical complaints, defined by the NHAMCS as primary reasons for the visit to the ED, were examined as potential confounders. The 2006 dataset includes additional demographic variables not present in the 2004 and 2005 sample, including median household income in patient's zip code, percent of patients with a bachelor's degree or higher in patient's zip code, and a five-level urban/rural classification of patient residence zip code for each visit. These additional factors were analyzed as a separate sub-analysis within the 2006 data in order to assess the influence of potential unmeasured socio-demographic confounders in the larger three year study.

Data Analysis

Statistical analysis of the data to obtain national estimates and appropriate variance estimates were conducted using survey set modules within Stata (version 10.1/SE for Windows, StataCorp LP College Station, TX). The analyses took into account the survey's weighted, clustered, and multistage sample design. For this study, 99% confidence intervals are reported throughout, and a p-value of 0.01 was used to demonstrate statistical significance, due to multiple comparisons and large numbers of observations.[29] Unadjusted sample-weighted bivariate analysis was performed using a Student's t-test, Wald test, and

chi-square methods to analyze baseline characteristics and to test the null hypothesis. A multivariable regression (using survey set module to account for survey weights) was used to determine if the primary association of interest (insurance and ambulance use) was confounded by inclusion of any of the individual covariates of interests. This was performed by building the model based on an a priori conceptual model and testing the regression with and without each individual co-variable in order to make sure that it did not change the results substantially.

A priori, it was determined that variables would meet criteria for confounding if either the relative odds or confidence intervals changed by 10%. Race and Hispanic ethnicity, year of study, U.S. Census Bureau classification of metropolitan statistical area (MSA), and region of the country were tested as demographic covariates of interest. Age, sex, immediacy of care required (triage class), and the presence or absence of the five most common reasons for visits were determined a priori to be included in the final model because of previous studies that have demonstrated their association with ambulance utilization and health insurance status.[3] Income and educational characteristics of zip code of residence were included in the adjusted model for the single year in which these data were available.

We hypothesized that the effect of insurance possession and type might be modified by metropolitan location, in part because EMS services in urban locations are more likely be municipal, taxpayer-subsidized services, and therefore are less likely to bill and collect fees from patients compared to non-municipal services.[18,30,31] We also had hypothesized that EMS use among patients with high urgency complaints could be insensitive to variations in insurance status, and therefore the effect of insurance status on EMS use might differ by triage acuity. To assess these hypotheses, we conducted the following analyses: we tested the interaction effects of insurance status with metropolitan location and then with triage acuity. For the acuity-interacted model we defined low-, medium-, and high-acuity as follows: low-acuity patients were discharged from the ED after evaluation and treatment, and were triaged as "safely able to be seen between 2 and 24 hours"; high-acuity patients were triaged as "needing to be seen in less than 15 minutes"; middle-acuity patients were patients with a triage classification of "able to be seen between 15 minutes and 2 hours," regardless of final disposition. The goal of these analyses was to determine if changes in any specific covariate or the combined effects of differences in the demographic characteristics or clinical condition may have accounted for relative differences in EMS use. For all regression analyses, goodness-of-fit was tested using the F adjusted mean residual test using STATA module *svylogitgof* for logistic regression analysis using complex survey sample data.[32]

RESULTS

For the 3-year study period, 61,013 unweighted patient visits were included, representing a national sample of about 70 million annual ED visits by non-institutionalized adults younger than 65 years of age between 2004 and 2006. In the entire sample, about 14% of the visits arrived by ambulance, 83% did not arrive by ambulance, and 4% of these visits had modes of arrival that were coded as missing or unknown.

Table 1 displays the baseline patient demographic characteristics as well as unadjusted comparisons of clinical factors by mode of arrival for included visits during the 3-year study period. Patients who arrived by ambulance were more likely to be men, to be older, and to have a higher triage acuity assessment compared to patients who did not arrive by ambulance. Considering the most common reasons for visit, those who arrived by ambulance were more likely to have chest pain (9.3% vs. 5.2%, $p < 0.001$) and shortness of breath (4.0% vs. 1.8% $p < 0.001$), while those who did not arrive by ambulance were more

likely to have headache (3.6% vs. 2.5%, p < 0.001), back pain (3.7% vs. 2.3%, p < 0.001), and upper extremity laceration (2.1% vs. 0.9%, p < 0.001).

In the unadjusted analysis, ED visits by patients with private insurance used an ambulance 11.5% of the time, patients without insurance used an ambulance 13.4% of the time, and patients with Medicaid used an ambulance 15.8% of the time (Medicaid vs. private p<0.001, Medicaid vs. self-pay p=0.001, self-pay vs private p=0.002).

The adjusted odds of arrival to the ED by ambulance vs. not by ambulance for a variety of patient characteristics are in Table 2. For this analysis, the post-estimation testing showed adequate goodness-of-fit. The association between insurance status and ambulance use was found to be independent of age, race, ethnicity, sex, transport to a hospital in an MSA, triage acuity, region of the country, chief complaint, and year of study. Compared to visits by patients with private insurance, those with Medicaid (aOR 1.60, 99% CI = 1.43 to 1.80) or without health insurance (aOR 1.43, 99% CI = 1.28 to 1.60) had significantly higher odds of arrival by ambulance. When compared to each other, visits by patients with Medicaid had smaller but significantly increased odds of ambulance use compared to uninsured visits (aOR 1.16, 99% CI = 1.03 to 1.30). Also included in the analysis (but not in the Table) were the visits by the unique group of patients under age 65 years with Medicare (chronically disabled or with end-stage renal disease), representing less than 5.7% of the included visits. The adjusted odds for ambulance use for this select group, compared to private insurance patient visits, was aOR 1.82 (99% CI = 1.5 to 2.2)

Male sex, older age, higher acuity classification, Northeast region, and MSA location of the ED were also each independently associated with higher adjusted odds of ambulance use for emergency care. However, these associations did not confound the magnitude or statistical significance of the association between insurance type and ambulance use. Using an enhanced model that included demographic co-variables available from the 2006 survey (median income, education level, and urban/rural character for each patient's zip code), an analysis was performed in 2006-only ED visits. In the 2006-only analysis, compared to visits by patients with private insurance, patients with Medicaid (aOR 1.54, 99% CI = 1.27 to 1.87) and patients without insurance (aOR 1.35, 99% CI = 1.10 to 1.66) had increased odds of ambulance use for prehospital care and transportation. When the original model (without the additional covariates) was applied to the 2006 only data, the results did not materially differ compared to the combined 2004 through 2006 data.

We measured a statistically significant positive interaction between lack of insurance and metropolitan location (*P* value for interaction term = 0.01), with MSAs accounting for the bulk of the increased odds of ambulance use among uninsured compared to private insurance visits. No other interaction effects measured, including those between triage acuity and insurance, were found to be statistically significant (*P* values for interaction terms ranged from 0.2 to 0.9). The adjusted associations between insurance and ambulance use, as interacted with metropolitan location and overall acuity, are shown in Tables 3 and 4. Other than for uninsured patients in non-metro areas, for whom odds of ambulance no longer appear to differ significantly from patient encounters with private insurance, the interaction results were not materially different from the findings of the adjusted overall model. We measured higher relative odds of ambulance use for visits by patients with Medicaid and without insurance relative to patients with private insurance within low-, medium-, and high-acuity episodes.

Six percent of the visits had incomplete insurance information documented in this sample. Complete insurance information was less likely to be found among ambulance arrivals than other modes of arrival (93% vs 94%, p = 0.005). In part because of this small but

statistically significant difference, we conducted a sensitivity analysis, reclassifying patient visits for which insurance status was initially classified as "unknown" or blank to "no insurance/self-pay," "Medicaid," or "private insurance," respectively. The results of the fully adjusted analysis, after incorporating the sensitivity tests, did not change the magnitude (ambulance use for Medicaid visits, aOR range 1.5 to 1.6, $p < 0.001$ compared to private insurance; ambulance use for self-pay visits, aOR range 1.3 to 1.4, $p < 0.001$), nor the significance of the findings.

DISCUSSION

Using a nationally representative sample of ED patients, this study sought to describe variations in ambulance use for patients aged 65 years and over seeking ED care across multiple factors, specifically individual health insurance possession and type. We found that ED visits by patients with private insurance were less likely to arrive by ambulance than patients with Medicaid or without health insurance. We also found that encounters by patients with Medicaid had significantly increased odds of ambulance use compared to those without insurance. These findings were statistically significant and independent of race, sex, acuity of presentation, and various demographic and geographic characteristics. The increased odds of ambulance use among patients with Medicaid persisted across urban and rural regions, whereas the odds of ambulance use for uninsured patients compared to privately insured patients were significantly elevated only within metropolitan areas.

This study is, to the best of our knowledge, the first to specifically evaluate the adjusted associations between insurance and emergency ambulance utilization using national data. Our findings, which demonstrate higher relative use of ambulance transport for patients with Medicaid or without health insurance, are consistent with results from previous single-center or unadjusted studies that have shown increased ambulance use among patients without insurance and/or with Medicaid.[24–27] By examining which patients use prehospital care among a group of patients who sought ED care, our study differs substantially from those that have compared patient ED use to non-ED use.[33–35] Specifically, our study examines the unique association of insurance with ambulance use among patients who are already planning to seek hospital-based emergency care.

The findings of this study appear to demonstrate multiple aspects of prehospital emergency care use that have not been previously explored in depth, and which may have specific policy implications.

First, EMS use is higher among those who historically have had difficulty accessing routine medical care, specifically poor and uninsured patients.[36] While not specifically mandated by the federal Emergency Medical Treatment and Active Labor Act (EMTALA), ambulance care and transport to the hospital is almost universally delivered without requiring proof of insurance or ability to pay.[37,38] For virtually all other forms of medical care, the uninsured have been noted to use less care than those with insurance[39]; the atypical findings in this study suggests that EMS may therefore serve as a part of the health care safety net, allowing patients without significant personal resources to receive services (including transportation to the hospital) that would be difficult to access otherwise. Our findings in the interaction analysis support this hypothesis: Medicaid patients, who are low-income by definition, may be the least likely to have access to private transportation, and therefore may be most likely to use ambulances both within and without metropolitan areas and across acute and non-acute medical conditions. Conversely, uninsured patients whose socioeconomic status is, as a group, more heterogeneous, may have easier access to transportation in rural areas where private vehicle ownership is more common.

Second, EMS use may vary by exposure to out-of-pocket costs. The highest relative rates of EMS use were among patients with the lowest potential personal costs: those with Medicaid for whom co-payments are absent or low, or those without insurance in metropolitan areas where publicly funded ambulance services are least likely to collect fees from the uninsured.[30,31,40]

The 2006 Institutes of Medicine report suggested that hospital-determined ambulance diversion, an increasing problem across the United States, might allow hospitals to avoid exposure to unprofitable Medicaid/uninsured patients.[4] Although privately insured visits make up the largest share of both ambulance and non-ambulance arrivals, the absolute percentage and the adjusted odds of ambulance use for visits with private insurance was significantly lower than those with Medicaid or without health insurance. While by no means conclusive, given that ambulance diversion may allow a hospital to see and treat more non-ambulance patients, our findings support the concerning possibility that such profit-maximizing strategies could indeed serve these ends, and therefore exacerbate disparities in the delivery of emergency health care.

National health reform will affect health insurance coverage for many adults under the age of 65 years, our specific study population. How these changes in coverage will affect the use of emergency health care services remains to be seen. Our findings, that relative ambulance use is highest among Medicaid visits, suggest that expansion of publically funded health insurance could drive increased EMS utilization (a concern, given the strained status of these systems). One potential response will be policies to increase co-payments and enforce fee collections for EMS care (which have been proposed as ways to maximize revenue and reduce inappropriate use).[21–23] However, our findings that insurance-driven variations in ambulance use are not attenuated by high triage acuity suggest that such blunt policy efforts may also create barriers to care for vulnerable patient populations during high-acuity episodes. Therefore, alternative and more refined strategies to reduce low-acuity EMS use, such as subsidized transportation options for low-income patients to health centers for non-urgent complaints, might improve the efficiency of EMS use without eroding the emergency safety net.

LIMITATIONS

Misclassification of mode of arrival, the primary outcome variable or any of the predictor covariates, represents a potential limitation. Because mode of arrival represents a standard part of emergency care documentation, we expect the quality control methods instituted by the NCHS to minimize this potential bias. Similarly, missing data may complicate the analysis. However, the primary outcome variable was subject to missing data rates of less than 4%. Although, as noted, other covariates such as insurance status had higher rates of missing data, the sensitivity analysis described in the methods did not uncover any significant biases in the analysis due to asymmetric distribution of missing insurance information. The covariate "immediacy of care" is noted to have the highest proportion of unknown classification (although NCHS identified and imputed the missing variables in this category, nearly 13% were evaluated in the EDs without a triage acuity, or with an unknown triage acuity). However, an "extreme imputation" sensitivity analysis, where the final models were re-run with all unknown triage acuity visits individually reclassified as highest, middle, then lowest triage acuity, did not reveal any substantial changes in the direction or significance of the reported associations.

One commonly recognized limitation of the NHAMCS is that the primary unit of analysis is patient encounter. Therefore, it is possible that individual patients are recorded multiple times, which would violate an assumption of independent observations. However, because

this is a survey that explores ED visits for a discrete period of time (4 weeks with approximately 100 patient visits sampled per hospital ED), it is unlikely that patients with multiple visits represent a significant proportion of the unique encounters.

The decision to use EMS care inherently includes the a priori decision to seek emergency care. Because insurance status can affect overall health as well as the decision and need to seek emergency care in general, this study may evaluate only a piece of the complex connection between health insurance coverage, personal health care decisions, and emergency care access and use. This study evaluates EMS use conditional on the decision to use emergency care; it does not account for patients who did not go the ED at all, patients who died before arriving to the hospital, and the rare cases where EMS providers do not transport the patient. The variations in conditional ambulance use among groups of patients with differing insurance status may be reflective of unmeasured factors associated with clinical, transportation, and cultural/demographic factors. While social and community norms may influence the way individuals use EMS, this analysis was able to account for race, age, ethnicity, region, and metropolitan residence, as well as education and income level of the patient zip code. Additionally, we accounted for clinical acuity as measured by triage classification, which has been previously validated as a measure of clinical severity.[41,42] However, the NHAMCS does not include variables such as comorbidities, which might better characterize patient severity. Therefore, we caution that this analysis cannot wholly explain the direct underlying causes of varying ambulance use in this sample.

CONCLUSIONS

In this national sample of U.S. emergency departments, patients younger than 65 years with Medicaid and those without health insurance were disproportionately more likely to use ambulances for transportation and/or care than those with private insurance. These findings may add value to policies that seek to match the delivery of prehospital transportation and care with societal needs.

REFERENCES

1. Pitts SR, Niska RW, Xu J, et al. National Hospital Ambulatory Medical Care Survey: 2006 emergency department summary. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. 2008 August 6.

2. McCaig LF, Nawar EW. National Hospital Ambulatory Medical Care Survey: 2004 emergency department summary. Adv Data. 2006; (372):1–29.

3. Burt CW, McCaig LF, Valverde RH. Analysis of ambulance transports and diversions among US emergency departments. Ann Emerg Med. 2006; 47(4):317–326. [PubMed: 16546615]

4. Committee on the Future of Emergency Care in the United States Health Services. Emergency Medical Services at the Crossroads. Washington, DC: Institute of Medicine National Academies Press; 2006.

5. Brown E, Sindelar J. emergent problem of ambulance misuse. Ann Emerg Med. 1993; 22(4):646–650. [PubMed: 8457089]

6. Billittier AJ, Moscati R, Janicke D, Lerner EB, Seymour J, Olsson D. A multisite survey of factors contributing to medically unnecessary ambulance transports. Acad Emerg Med. 1996; 3:1046–1050. [PubMed: 8922014]

7. Morris DL, Cross AB. Is the emergency ambulance service abused? Br Med J. 1980; 281(6233):121–123. [PubMed: 7427211]

8. Gardner GJ. The use and abuse of the emergency ambulance service: some of the factors affecting the decision whether to call an emergency ambulance. Arch Emerg Med. 1990; 7(2):81–89. [PubMed: 2390158]

9. Snooks H, Wrigley H, George S, Thomas E, Smith H, Glasper A. Appropriateness of use of emergency ambulances. J Accid Emerg Med. 1998; 15(4):212–215. [PubMed: 9681300]

10. Camasso-Richardson K, Wilde JA, Petrack EM. Medically unnecessary pediatric ambulance transports: a medical taxi service? Acad Emerg Med. 2000; 7:1137–1141.

11. Richards JR, Ferrall SJ. Inappropriate use of emergency medical services transport: comparison of provider and patient perspectives. Acad Emerg Med. 1999; 6:14–20. [PubMed: 9928971]

12. Rademaker AW, Powell DG, Read JH. Inappropriate use and unmet need in paramedic and nonparamedic ambulance systems. Ann Emerg Med. 1987; 16(5):553–556. [PubMed: 3494411]

13. Mosca L, Mochari-Greenberger H, Dolor RJ, Newby LK, Robb KJ. Twelve-year follow-up of American women's awareness of cardiovascular disease risk and barriers to heart health. Circ Cardiovasc Qual Outcomes. 2010; 3(2):120–127. [PubMed: 20147489]

14. Mosley I, Nicol M, Donnan G, Patrick I, Kerr F, Dewey H. The impact of ambulance practice on acute stroke care. Stroke. 2007; 38(10):2765–2770. [PubMed: 17717317]

15. Rokos IC, French WJ, Koenig WJ, et al. Integration of pre-hospital electrocardiograms and ST-elevation myocardial infarction receiving center (SRC) networks: impact on door-to-balloon times across 10 independent regions. JACC Cardiovasc Interv. 2009; 2(4):339–346. [PubMed: 19463447]

16. Phelps MA, Rodriguez RM, Passanante M, et al. EMS activation in a cohort of critically ill patients. J Emerg Med. 2002; 22(2):127–131. [PubMed: 11858915]

17. Canto JG, Zalenski RJ, Ornato JP, et al. Use of emergency medical services in acute myocardial infarction and subsequent quality of care: observations from the National Registry of Myocardial Infarction 2. Circulation. 2002; 106(24):3018–3023. [PubMed: 12473545]

18. Siepmann DB, Mann NC, Hedges JR, Daya MR. Association between prepayment systems and emergency medical services use among patients with acute chest discomfort syndrome. Ann Emerg Med. 2000; 35(6):573–578. [PubMed: 10828770]

19. Smolderen KG, Spertus JA, Nallamothu BK, et al. Health care insurance, financial concerns in accessing care, and delays to hospital presentation in acute myocardial infarction. JAMA. 2010; 303(14):1392–1400. [PubMed: 20388895]

20. Groom DJ. Frequent flyers abuse ambulance rules for a free ride to hospitals. Syracuse Post-Standard. 2010 Feb. 7.

21. Hoffmann N. Following the money: patient costs could rise with new ambulance service. Napa Valley Register. 2010 August 1.

22. Olson B. Cost of ambulance ride could be going up. Houston Chronicle. 2010 Feb 10.

23. Paige, R. KCAL9; CBS Los Angeles: Insult to injury: ambulance costs can cut deep. Available at: http://freerepublic.com/focus/f-chat/2457955/posts

24. Ruger JP, Richter CJ, Lewis LM. Clinical and economic factors associated with ambulance use to the emergency department. Acad Emerg Med. 2006; 13:879–885. [PubMed: 16825670]

25. Larkin GL, Claassen CA, Pelletier AJ, Camargo CA Jr. National study of ambulance transports to United States emergency departments: importance of mental health problems. Prehosp Disaster Med. 2006; 21(2):82–90. [PubMed: 16770997]

26. Rucker DW, Edwards RA, Burstin HR, O'Neill AC, Brennan TA. Patient-specific predictors of ambulance use. Ann Emerg Med. 1997; 29(4):484–491. [PubMed: 9095009]

27. Squire BT, Tamayo A, Tamayo-Sarver JH. At-risk populations and the critically ill rely disproportionately on ambulance transport to emergency departments. Ann Emerg Med. 2010; 56(4):341–347. [PubMed: 20554351]

28. Shah MN, Bazarian JJ, Lerner EB, et al. The epidemiology of emergency medical services use by older adults: an analysis of the National Hospital Ambulatory Medical Care Survey. Acad Emerg Med. 2007; 14:441–447. [PubMed: 17456555]

29. Hing E, Gousen S, Shimizu IM, et al. Guide to using masked design variables to estimate standard errors in public use files of the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey. Inquiry. 2003/2004; 40(4):415–416.

30. Fitch, JJ. Prehospital care administration: issues, readings, cases. Carlsbad, CA: JEMS Communications; 1995.

31. Kuehl, A. Prehospital systems and medical oversight. 3rd ed.. Dubuque, IA: Kendall/Hunt Pub.; 2002. National Association of EMS Physicians (U.S.).

32. Archer KJ, Lemeshow S. Goodness-of-fit test for a logistic regression model fitted using survey sample data. Stata J. 2006; 6(1):97–105.

33. Weber EJ, Showstack JA, Hunt KA, Colby DC, Callaham ML. Does lack of a usual source of care or health insurance increase the likelihood of an emergency department visit? Results of a national population-based study. Ann Emerg Med. 2005; 45(1):4–12. [PubMed: 15635299]

34. Weber EJ, Showstack JA, Hunt KA, et al. Are the uninsured responsible for the increase in emergency department visits in the United States? Ann Emerg Med. 2008; 52(2):108–115. [PubMed: 18407374]

35. Cunningham PJ. What accounts for differences in the use of hospital emergency departments across U.S. communities? Health Aff. 2006; 25(5):w324–w336.

36. Felland LE, Lauer JR, Cunningham PJ. Suburban poverty and the health care safety net. Res Briefs. 2009; (13):1–12. [PubMed: 19685599]

37. Zibulewsky J. The Emergency Medical Treatment and Active Labor Act (EMTALA): what it is and what it means for physicians. Proc (Bayl Univ Med Cent). 2001; 14(4):339–346. [PubMed: 16369643]

38. West JC. EMTALA extended to ambulances not owned by hospital. Arrington v. Wong. J Healthc Risk Manag. 2001; 21(3):29–31.

39. Hadley J. Insurance coverage, medical care use, and short-term health changes following an unintentional injury or the onset of a chronic condition. JAMA. 2007; 297(10):1073–1084. [PubMed: 17356028]

40. Kaiser Family Foundation. [Accessed July 15, 2011] Medicaid Benefits: Online Database. Available at: http://medicaidbenefits.kff.org/

41. Eitel DR, Travers DA, Rosenau AM, Gilboy N, Wuerz RC. The emergency severity index triage algorithm version 2 is reliable and valid. Acad Emerg Med. 2003; 10:1070–1080. [PubMed: 14525740]

42. Wuerz R. Emergency severity index triage category is associated with six-month survival. ESI Triage Study Group. Acad Emerg Med. 2001; 8:61–64. [PubMed: 11136151]

Table 1

Patient characteristics by mode of arrival for included visits.

	Arrived by Ambulance n=8,634 (estimate 27.9 million)		Did Not Arrive by Ambulance n=52,379 (estimate 173 million)		P value
	Percent	99% CI	Percent	99 % CI	
2004–2006					
Mean age, years	41	40.4–41.6	37	36.8–37.4	<0.001*
Female	51.5	50.0–53.0	56.6	55.9–57.2	<0.001*
Hispanic ethnicity	13.2	11.5–5.1	12.5	10.7–14.5	0.262
Race					0.031
White	71.6	68.7–74.2	72.6	68.7–76.1	
Black or African American	24.4	21.8–27.2	24.4	20.9–28.2	
Other	4.1	3.1–5.4	3.1	2.3–4.0	
Expected source of payment					<0.001*
Private	32.5	33.0–35.1	40.0	37.9–42.4	
Medicaid	23.2	20.7–25.8	19.8	18.1–21.7	
Charity/ self-pay	22.9	20.8–25.2	23.8	21.6–26.1	
Medicare	9.0	7.9–10.2	5.2	4.7–5.9	
Other	5.3	4.3–6.5	5.3	4.5–6.3	
Unknown	7.1	5.5–9.1	5.8	4.5–7.4	<0.001*
Assessed immediacy of care					
<15 minutes	30.5	37.5–33.8	11.4	9.7–13.3	
15–60 minutes	36.8	33.5–40.1	35.8	31.9–39.8	
1–2 hours	13.7	11.8–16.0	23.3	20.7–26.2	
>2 –24 hours	5.8	4.6–7.4	14.7	12.3–17.5	
Unknown	13.1	10.3–16.6	14.8	11.6–18.7	
Hospital region					<0.001*
Northeast	24.5	19.3–30.5	19.0	16.1–22.4	
Midwest	22.9	16.9–30.2	23.3	17.9–29.7	
South	34.6	28.2–41.6	40.1	34.3–46.3	
West	18.0	13.7–23.4	17.5	14.1–21.4	

	Arrived by Ambulance n=8,634 (estimate 27.9 million)		Did Not Arrive by Ambulance n=52,379 (estimate 173 million)		P value
	Percent	99 % CI	Percent	99 % CI	
Hospital urbanicity					<0.001[*]
MSA	91.1	82.6–95.7	85.2	72.3–92.7	
Non-MSA	8.9	4.3–17.4	14.8	7.3–27.7	
2006 only	**Arrived by Ambulance n=2,880 (estimate 9.89 million)**		**Did Not Arrive by Ambulance n=17,474 (estimate 61.7 million)**		
Percent poverty by zip-code					0.250
< 5%	12.2	9.5–5.7	11.9	9.4–15.0	
5% to 9.99%	21.7	17.9–26.1	24.8	20.9–29.2	
10% to 19.99%	35.9	31.5–40.7	35.8	30.6–41.5	
20% or more	24.8	20.1–30.1	22.8	18.1–28.3	
Unknown	5.4	3.2–8.9	4.6	3.5–6.0	
Urban/rural by zip code					0.004[*]
Large central metro	30.5	21.4–41.4	25.8	18.9–34.2	
Large fringe metro	21.6	15.9–28.6	20.8	15.3–27.6	
Medium metro	22.8	14.4–34.1	22.3	17.3–33.0	
Small metro	10.0	4.6–20.3	11.3	4.5–21.7	
Non-metro	11.2	6.9–17.8	17.0	9.6–28.3	
Unknown	3.9	6.9–7.9	2.8	1.8–4.3	
College educated by zip code					0.580
<12.84%	29.4	24.4–35.0	31.8	26.5–37.6	
12.84% to 19.66%	25.4	21.1–30.2	25.2	20.9–30.1	
19.67 to 31.68%	21.5	18.0–25.5	21.3	17.8–25.4	
31.69% or more	18.2	14.5–22.6	16.9	13.8–20.7	
Unknown	5.4	3.2–9.0	4.7	3.6–6.0	
Median household income by zip code					0.748
Below 32,793	32.7	28.0–37.7	32.7	27.5–38.5	
$32,794–$40,626	24.9	20.6–29.8	26.0	21.5–31.1	
$40,627–$52,387	19.7	16.0–23.9	20.4	16.6–24.7	
$52,388 or more	17.4	13.6–22.1	16.4	13.2–20.0	

	Arrived by Ambulance n=8,634 (estimate 27.9 million)		Did Not Arrive by Ambulance n=52,379 (estimate 173 million)		P value
	Percent	99% CI	Percent	99 % CI	
Unknown	5.3	3.2–8.9	4.6	3.5–5.9	

*
p≤0.01

Table 2

Adjusted odds of arriving by ambulance compared to alternate modes of transportation 2004–2006.

Visit Characteristic n=48,443	Percent Ambulance Use	aOR	99% CI
Expected primary payer[**]			
Private insurance	11.5	Reference	
Medicaid	15.8	1.60	1.37–1.86
Self-pay/charity	13.4	1.43	1.23–1.66
Other (non-Medicare)	13.8	1.35	1.04–1.75
Sex			
Male	15.2	Reference	
Female	12.8	0.88	0.80–0.96
Age in years			
18–24	10.5	Reference	
25–34	11.0	1.07	0.91–1.24
35–44	13.4	1.28[*]	1.10–1.48
45–54	16.3	1.56[*]	1.34–1.82
55–64	22.0	2.15[*]	1.79–2.57
Triage level/immediacy			
<15 minutes	30.1	Reference	
15–60 minutes	14.2	0.41[*]	0.35–0.49
1–2 hours	8.7	0.24[*]	0.19–0.29
>2 hours	6.0	0.15[*]	0.12–0.20
Metropolitan Statistical Area			
MSA	14.7	Reference	
non-MSA	8.8	0.52[*]	0.38–0.71
Race / ethnicity			
White	13.7	Reference	
Black or African American	13.9	0.94	0.82–1.08
Other	17.7	1.24	0.88–1.73
Non-Hispanic	13.8	Reference	
Hispanic	14.5	0.96	0.82–1.23
Year			
2004	13.8	Reference	
2005	14.0	1.01	0.82–1.25
2006	13.8	0.95	0.80–1.14
Region			
Northeast	17.1	Reference	
Midwest	13.6	0.76	0.55–1.07
South	12.2	0.70[*]	0.53–0.92

Visit Characteristic n=48,443	Percent Ambulance Use	aOR	99% CI
West	14.3	0.73[*]	0.53–0.99

Model adjusted for listed characteristics as well as 5 most common reasons for visits, and additional payer types.

[**] Estimates listed in text for non-senior Medicare.

[*] $p \leq 0.01$

Table 3

Adjusted relative odds of arriving by ambulance compared to alternate modes of transportation 2004–2006, by acuity.

Expected Primary Payer	% Ambulance Use (unadjusted)	aOR	99% CI
Low acuity n=7,297			
Private insurance	4.2	Reference	
Medicaid	6.1	1.65	1.21–2.26[*]
Self-pay/charity	5.9	1.63	1.20–2.20[*]
Other (non-Medicare)	5.6	1.30	0.64–2.6
Medium acuity n=32,577			
Private insurance	10.0	Reference	
Medicaid	14.0	1.55	1.29–1.90[*]
Self-pay/charity	11.9	1.37	1.15–1.62[*]
Other (non-Medicare)	12.4	1.30	0.94–1.75
High acuity n=8,228			
Private insurance	24.6	Reference	
Medicaid	34.0	1.78	1.39–2.27[*]
Self-pay/charity	30.4	1.53	1.21–1.92[*]
Other (non-Medicare)	29.2	1.52	0.99–2.32

Multivariable logistic regression model adjusted for race, gender, age, Hispanic ethnicity, MSA, region of the country, survey year, five most common reasons for visits, and additional payer types.

[*] p≤0.01

Low-acuity: no admission/transfer *plus* acceptable to be seen in >2 hours
Medium-acuity: acceptable to be seen between 15 minutes and 2 hours
High-acuity: must be seen in <15 minutes

Table 4

Adjusted relative odds of arriving by ambulance compared to alternate modes of transportation 2004–2006.

Expected Primary Payer	Percent Ambulance Use (unadjusted)	Adjusted Odds Ratio	99% CI
Metropolitan Statistical Area (MSA) n=42,771			
Private insurance	12.1	Reference	
Medicaid	16.8	1.61[*]	1.37–1.90
Self-pay/charity	14.4	1.48[*]	1.26–1.74
Other (non-Medicare)	15.3	1.44[*]	1.09–1.90
Non-MSA n=5672			
Private insurance	8.0	Reference	
Medicaid	10.5	1.50[*]	1.02–2.08
Self-pay/charity	7.3	0.96	0.68–1.37
Other (non-Medicare)	6.2	0.74	0.36–1.50

Multivariable logistic regression model adjusted for race, sex, age, Hispanic ethnicity, region of the country, triage acuity, five most common reasons for visits, and additional payer types.

[*] p≤0.01